PATENT SPECIFICATION

DRAWINGS ATTACHED

Inventor: KEITH WATSON TODD

840,543

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COMPLETE SPECIFICATION

Improvements in Turbine Blading

SPECIFICATION NO. 840,543

INVENTOR: KEITH WATSON TODD

By a direction given under Section 17 (1) of the Patents Act 1949 this application proceeded in the name of Associated Electrical Industries Limited, of 33, Grosvenor Place, London, S.W.1., a British Company.

THE PATENT OFFICE
28th November, 1960

DS 82956/1(23)/8500 200 11/60 DL

wards. Moreover, if the channel is further bounded by what might conventionally be called a floor and a ceiling, the effect of such boundaries or of an uneven distribution of velocity in flow upstream of a given section of the channel, is to produce a non-uniform distribution of centrifugal force (and therefore of pressure) resulting in the formation of a pair of vortices, one adjacent the floor and the other adjacent the ceiling. These vortices are known as vortex pairs. Flow in such vortices, transverse the main or primary flow, is known as secondary flow.

In turbines, vortex pairs persist independently in each passage formed by adjacent blades or vanes, and are associated with other vortices in the efflux from the passages. Vortices absorb energy, and thus the formation of vortices is one form of loss. It is the object of the invention to prevent or minimise the formation of vortices within the blading of turbine machines.

The invention consists in utilising blades or vanes provided with one or more transverse fins designed to interrupt or reduce any secondary flow in the working fluid, and thus [illegible] floor 3 which constitutes one wall of the curved channel formed by adjacent blades. The top of the blades will normally be connected by a shroud indicated by chain-dotted lines A A, the shroud forming an end wall or ceiling of the channel formed by adjacent blades.

The channel between the blades is thus limited by curved side walls of which one wall is concave and is formed by the face of the blade illustrated while the other side wall of the channel is convex and is formed by the rear face of the adjacent blade.

The floor and ceiling are thus substantially flat and parallel end walls of the channel through which fluid flow takes place, the channel being of substantially rectangular cross-section in planes at right angles to the axis of fluid flow.

According to the invention, in a turbine blade provided with a single transverse fin, or two or more such fins spaced longitudinally of the blade projecting from the surface of the blade, the projection of the, or each, fin being in a plane lying substantially at right angles to the longitudinal axis of the blade, the, or each,

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COMPLETE SPECIFICATION

Improvements in Turbine Blading

We, METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED, a British Company, having its registered office at St. Paul's Corner, 1/3 St. Paul's Churchyard, London, E.C.4, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to turbines in which working fluid is constrained to flow through curved passages or channels formed by adjacent blades or vanes.

It is known that for equilibrium of flow of a compressible fluid constrained by a curved channel, the centrifugal forces induced by the curvature of the path must be balanced by pressure gradients which decline radially inwards. Moreover, if the channel is further bounded by what might conventionally be called a floor and a ceiling, the effect of such boundaries or of an uneven distribution of velocity in flow upstream of a given section of the channel, is to produce a non-uniform distribution of centrifugal force (and therefore of pressure) resulting in the formation of a pair of vortices, one adjacent the floor and the other adjacent the ceiling. These vortices are known as vortex pairs. Flow in such vortices, transverse the main or primary flow, is known as secondary flow.

In turbines, vortex pairs persist independently in each passage formed by adjacent blades or vanes, and are associated with other vortices in the efflux from the passages. Vortices absorb energy, and thus the formation of vortices is one form of loss. It is the object of the invention to prevent or minimise the formation of vortices within the blading of turbine machines.

The invention consists in utilising blades or vanes provided with one or more transverse fins designed to interrupt or reduce any secondary flow in the working fluid, and thus to prevent, restrict or break-down vortices within the primary flow, the fins being so proportioned as to offer the minimum resistance to the primary flow.

The fins may be integral with the blade or attached thereto by any of the known methods.

In the drawings accompanying the provisional specification a blade provided with fins is shown in Fig. 1 in perspective view, Figs. 2 and 3 showing sections of the blades with two differing arrangements of the fins.

Referring to Fig. 1 the root portion 1 of the blade 2 is adapted to be secured to the turbine wheel. In a blade ring there will normally be a number of blades similar to that illustrated in Fig. 1 arranged in a ring with the faces of the root portions in contiguity and the upper faces of the root portions forming a continuous floor 3 which constitutes one wall of the curved channel formed by adjacent blades. The top of the blades will normally be connected by a shroud indicated by chain-dotted lines A A, the shroud forming an end wall or ceiling of the channel formed by adjacent blades.

The channel between the blades is thus limited by curved side walls of which one wall is concave and is formed by the face of the blade illustrated while the other side wall of the channel is convex and is formed by the rear face of the adjacent blade.

The floor and ceiling are thus substantially flat and parallel end walls of the channel through which fluid flow takes place, the channel being of substantially rectangular cross-section in planes at right angles to the axis of fluid flow.

According to the invention, in a turbine blade provided with a single transverse fin, or two or more such fins spaced longitudinally of the blade projecting from the surface of the blade, the projection of the, or each, fin being in a plane lying substantially at right angles to the longitudinal axis of the blade, the, or each,

fin extends across both faces of the blade to project beyond the trailing edge thereof, whereby to minimise the formation of vortices in the working fluid flowing within the curved channel formed between adjacent blades. The fins are preferably provided near the floor and ceiling of the blades, as indicated.

The fins may be formed during the process of machining the blade so that they constitute an integral part of the blade; alternatively, they may be preformed so as to fit on to the wholly or partly machined blade and be welded thereto, the blade with the fins attached thereto being finally finished to shape.

The blades may or may not be directly shrouded. When they are not shrouded, the stator casing of the turbine forms the shroud. When they are shrouded a tag projection is formed at the top of the balde which is inserted in a corresponding hole in the strip-like shroud and rivetted over. The shroud is not continuous circumferentially, but is divided up into separate pieces covering six or more blades for expansion and to facilitate assembly.

The blade root is shown as being of generally rectangular form. In practice, it will usually be shaped in the well-known "fir-tree" or other interlocking section to enable it to be fitted into the correspondingly shaped groove in the rotor blade ring or disc.

WHAT WE CLAIM IS:—

1. A turbine blade having a single transverse fin, or two or more such fins spaced longitudinally of the blade, projecting from the surface of the blade, the projection of the, or each, fin being in a plane lying substantially at right angles to the longitudinal axis of the blade, wherein the, or each, fin extends across both faces of the blade to project beyond the trailing edge thereof, whereby to minimise the formation of vortices in the working fluid flowing within the curved channel formed between adjacent blades.

2. A turbine blade constrcuted substantially as described with reference to the drawings filed with the provisional specification.

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PROVISIONAL SPECIFICATION

Improvements in Turbine Blading

We, METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED, a British Company, having its registered office at St. Paul's Corner, 1/3, St. Paul's Churchyard, London, E.C.4, do hereby declare this invention to be described in the following statement:—

In machines of the turbine type, which includes turbines, compressors, fans, blowers and the like, the working fluid is constrained to flow through curved passages or channels formed by adjacent blades or vanes.

It is known that for equilibrium of flow of a compressible fluid constrained by a curved channel, the centrifugal forces induced by the curvature of the path must be balanced by pressure gradients which decline radially inwards. Moreover, if the channel is further bounded by what might conventionally be called a floor and a ceiling, the effect of such boundaries, or of an uneven distribution of velocity in flow upstream of a given section of the channel, is to produce a non-uniform distribution of centrifugal force (and therefore of pressure) resulting in the formation of a pair of vortices, one adjacent the floor and the other adjacent the ceiling. These vortices are known as vortex pairs. Flow in such vortices, transverse the main or primary flow, is known as secondary flow.

In turbine machines, vortex pairs persist independently in each passage formed by adjacent blades or vanes, and are associated with other vortices in the efflux from the passages. Vortices absorb energy, and thus the formation of vortices is one form of loss. It is the object of the invention to prevent or minimise the formation of vortices within the blading of turbine machines.

The invention consists in utilising blades or vanes provided with one or more transverse fins or fences designed to interrupt or reduce any secondary flow in the working fluid, and thus to prevent, restrict or break-down vortices within the primary flow, the fins being so proportioned as to offer the minimum resistance to the primary flow.

The fins or fences may extend across all or part of the blade width or beyond the leading and/or trailing edges. The fins may be integral the blade or attached thereto by any of the known methods.

In the accompanying drawings a blade provided with fins is shown in Fig. 1 in perspective view, Figs. 2 and 3 showing sections of the blades with two differing arrangements of the fins.

Referring to Fig. 1 the root portion 1 of the blade 2 is adapted to be secured to the turbine wheel. In a blade ring there will normally be a number of blades similar to that illustrated in Fig. 1 arranged in a ring with the faces of the root portions in contiguity and the upper faces of the root portions forming a continuous floor 3 which constitutes one wall of the curved channel formed by adjacent blades. The top of the blades will normally be connected by a shroud indicated by chain-dotted lines AA, the shroud forming an end wall or

ceiling of the channel formed by adjacent blades.

The channel between the blades is thus limited by curved side walls of which one wall is concave and is formed by the face of the blade illustrated while the other side wall of of the channel is convex and is formed by the rear face of the adjacent blade.

The wall and ceiling are thus substantially flat and parallel end walls of the channel through which fluid flow takes place, the channel being of substantially rectangular cross-section in a plane at right angles to the axis of fluid flow.

According to the invention the blade is provided with transverse fins or fences 4 which are arranged transverse to the blade and may extend across a part of the blade only, as shown in Figs. 1 and 2, or across the whole of the blade, as shown in Fig. 3. The fins 4 may extend beyond the leading and/or trailing edges of the blades if desired, although they have only been shown as projecting beyond the trailing edge in the drawing. The fins are preferably provided near the floor and ceiling of the blades, as indicated.

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840,543 PROVISIONAL SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

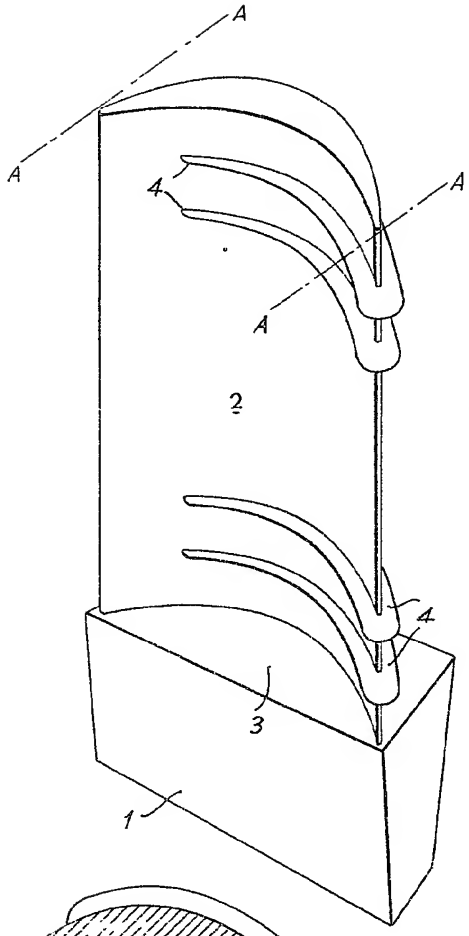

Fig. 1.

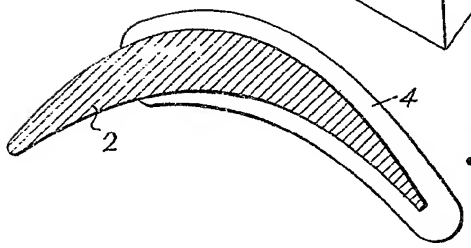

Fig. 2.

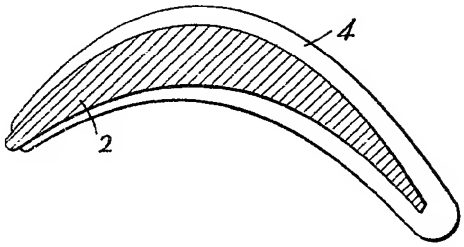

Fig. 3.